Claims

What is claimed is:

1. An optical device, comprising:

an input and output optical module to receive input light and to export output light;

an optical processing module to receive the input light from said input and output optical module, and to control polarization of light in processing the input light and directing the output light to said input and output optical module; and

a reflector to receive processed light from said optical processing module and to reflect the processed light back to said optical processing module which further processes the reflected processed light according to polarization to produce the output light.

2. The device as in claim 1, wherein said input and output optical module comprises a first dual fiber collimator having a first pair of fibers with one fiber as a first input and another fiber as a first output, and a second dual fiber collimator having a second pair of fibers with one fiber as a second input and another fiber as a second output.

3. The device as in claim 2, wherein said optical processing module comprises:

a first birefringent beam displacer placed in optical paths of said first pair of fibers to separate first input light into two orthogonally polarized beams in first and second polarization directions, respectively;

a first half-wave plate in a path of light in said first polarization direction to or from said first birefringent beam displacer;

a second birefringent beam displacer placed in optical paths of said first pair of fibers to separate second input light into two orthogonally polarized beams in said first and said second polarization directions, respectively;

a second half-wave plate in a path of light in said second polarization direction to or from said second birefringent beam displacer;

a polarization beam splitter in optical paths of light beams passing through said first and said second birefringent beam displacers to combine beams from said first and said second birefringent beam displacers into a single beam along a common optical path and to split light received from said common optical path into orthogonally polarized beams that are received by said first and said second birefringent beam displacers, respectively,

wherein said reflector is located at an end of said common optical path to reflect light from said polarization beam splitter back to retrace said common optical path; and

a polarization rotator located in said common optical path between said polarization beam splitter and said reflector to rotate a polarization of light by 90 degrees for each light beam after being reflected by said reflector.

4. The device as in claim 3, wherein said polarization rotator comprises a Faraday rotator.

5. The device as in claim 3, wherein said polarization rotator comprises a liquid-crystal cell.

6. The device as in claim 3, wherein said polarization rotator comprises an optical birefringent element.

7. The device as in claim 3, wherein said optical processing module further comprises a quarter-wave plate located in said common optical path between said polarization element and said reflector.

8. The device as in Claim 7, wherein an optic axis of said quarter-wave plate is at 22.5 degrees with respect to said first and said second polarization directions.

9. The device as in claim 3, wherein said polarization rotator is tunable in response to a control to either produce the rotation of 90 degrees or leave polarization of light unchanged.

10. The device as in claim 3, wherein said reflector is partially transmissive, and wherein said device further comprises an optical detector located to receive transmission of light through said reflector.

11. The device as in claim 1, wherein said optical processing module comprises:

a first birefringent beam displacer to receive and separate first input light from said input and output optical module into two orthogonally polarized beams in first and second polarization directions, respectively;

a first half-wave plate in a path of light in said first polarization direction to or from said first birefringent beam displacer;

a second birefringent beam displacer to receive and separate second input light from said input and output optical module into two orthogonally polarized beams in said first and said second polarization directions, respectively;

a second half-wave plate in a path of light in said second polarization direction to or from said second birefringent beam displacer;

a polarization beam splitter in optical paths of light beams passing through said first and said second birefringent beam displacers to combine beams from said first and said second birefringent beam displacers into a single beam along a common optical path and to split light received from said common optical path into orthogonally polarized beams that are received by said first and said second birefringent beam displacers, respectively,

wherein said reflector is located at an end of said common optical path to reflect light from said polarization beam splitter back to retrace said common optical path and is partially transmissive to transmit a fraction of received light as a monitor beam;

a polarization rotator located in said common optical path between said polarization beam splitter and said reflector, said polarization rotator operable to rotate a polarization of light

by 90 degrees for each light beam after being reflected by said reflector; and

an optical detector positioned relative to said reflector to receive said monitor beam and to produce a monitor signal indicative information in light reflected by said reflector.

12. The device as in claim 1, wherein said input and output optical module comprises a polarization beam splitter having a first optical port to receive input light and a second optical port to export output light, said polarization beam splitter splitting the input light into two beams with orthogonal polarizations and combining the two beams to produce the output light,

wherein said optical processing module comprises:

an internal reflector operable in combination with said reflector to direct the two beams with orthogonal polarizations to counter propagate with each other before being recombined at said polarization beam splitter, and

a tunable polarization rotator in an optical path of the two counter-propagating beams with orthogonal polarizations, said tunable polarization rotator operable to rotate polarizations of the two beams by a common amount in response to a control.

13. The device as in claim 1, wherein said input and output optical module comprises a dual fiber collimator having an input fiber to receive the input light and an output fiber to receive the output light from said optical processing module for export, and

wherein said optical processing module comprises:

a birefringent beam displacer to receive and separate the input light from said input fiber into two orthogonally polarized beams in first and second polarization directions, respectively, wherein said birefringent beam displacer further directs reflected light from said reflector to said output fiber; and

a tunable polarization rotator between said birefringent beam displacer and said reflector, said tunable polarization rotator operable to rotate polarization of light traveling between said birefringent beam displacer and said reflector in response to a control.

14. The device as in claim 13, wherein said optical processing module further comprises a quarter-wave plate located between said birefringent beam displacer and said reflector.

15. The device as in claim 13, wherein said reflector is partially transmissive, and wherein said device further

comprises an optical detector located to receive transmission of light through said reflector.

16. The device as in claim 1, wherein said reflector is partially transmissive, and wherein said device further comprises an optical detector located to receive transmission of light through said reflector.

17. A method, comprising:

providing a first birefringent beam displacer to receive and separate first input light into two orthogonally polarized beams in first and second polarization directions, respectively;

using a first half-wave plate in a path of light in said first polarization direction to or from said first birefringent beam displacer;

providing a second birefringent beam displacer to receive and separate second input light from said input and output optical module into two orthogonally polarized beams in said first and said second polarization directions, respectively;

using a second half-wave plate in a path of light in said second polarization direction to or from said second birefringent beam displacer;

using a polarization beam splitter in optical paths of light beams passing through said first and said second

birefringent beam displacers to combine beams from said first and said second birefringent beam displacers into a single beam along a common optical path and to split light received from said common optical path into orthogonally polarized beams that are received by said first and said second birefringent beam displacers, respectively;

reflecting light from said polarization beam splitter back to retrace said common optical path with a reflector that is partially transmissive to transmit a fraction of received light as a monitor beam; and

using a polarization rotator in said common optical path between said polarization beam splitter and said reflector to rotate a polarization of light by 90 degrees for each light beam after being reflected by said reflector to direct reflection of said first input light into said first birefringent beam displacer and said reflection of said second input light into said first birefringent beam displacer.

18. The method as in claim 17, further comprising placing an optical detector relative to said reflector to receive said monitor beam and to produce a monitor signal indicative information in light reflected by said reflector.

19. A method, comprising:

using a birefringent beam displacer to separate an input beam into two separate input beams with orthogonal polarizations;

after the two separate input beams with orthogonal polarizations exit the birefringent beam displacer, reflecting the two separate input beams with orthogonal polarizations to retrace their optical paths back to the birefringent beam displacer and combing the reflected two separate input beams with orthogonal polarizations into an output beam; and

rotating polarization of both of the two separate input beams with orthogonal polarizations prior to their re-entry to the birefringent beam displacer by a same angle to control a power level of the output beam.

20. The method as in claim 19, further comprising taping a fraction of the two separate input beams with orthogonal polarizations at the location of the reflecting to produce a monitor signal.